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# Bioactive Components of Pulses and their Impact on Human Health and Nutrition

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**ABSTRACT**

Pulses are important food crops cultivated globally for their high nutritional value. Chickpea, pigeon pea, mungbean, urdbean, lentil, rajmash and filed pea are the major pulsesgrown in India. They are the key source of protein for the predominantly vegetarian population of the country. Besides protein, they also contain carbohydrates, fat, vitamins and various micronutrients. In addition, pulses also have many non-nutritive bioactive components such as phenolic compounds, dietary fibre, enzyme inhibitors, lectins, phytic acid, phytosterols, and saponins. Although, most of them are considered antinutritional factors, but recent studies have demonstrated their role in the prevention of diet-associated diseases such as cancer, diabetes, and cardiovascular ailments. The current article discusses the nutritional worth of pulses and their impact on human health.

## Introduction :

Pulses have many nutritional attributes. They have protein, fat and carbohydrates which contribute to the total calorific value of the pulses. They also have vitamins, various minerals and other bioactive compounds which have several health-beneficial effects on the human body.

## Carbohydrates :

Carbohydrate is a major component of pulses and it varies from 43.2 g (Chickpea)to 62.0 g (Pea)/100-gram dry weight(FAO database). They primarily have a role in contributing towards the energy supply to the body. Starch is the major carbohydrate fraction of pulses and it is characterized as slowly digestible (Mudryj and Aukema, 2014). Pulse starch being amylose rich has unique health-promoting properties such as its role as a prebiotic, induction of satiety, reduction of calorie in take, reduction of serum cholesterol and TAG (triacylglycerides), lowering the blood glucose concentration and reduction of obesity. Pulses also contain resistant starch, a type of carbohydrate that behaves like fibre in the body; and has been shown to have similar health benefits such as

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reduced circulating cholesterol and blood sugar levels as well as improved gut health (Singh *et al.*, 2016).

**Protein :**

Pulses are an important source of protein for vegetarian people. The protein content of pulses varies from 20.4 % (Chickpea) to 26.9 % (Lentil) which is about twice that of cereals(FAO database; Mukharjee *et al.*, 2017). It is required for the repair of body tissues, and the synthesis of enzymes and hormones. Most grains have a poor balance of essential amino acids. The cereals (maize, wheat, rice, etc.) tend to below in lysine (Lys), whereas legumes are oftenlow inthe sulfur-rich amino acids methionine (Met) and Cystine (Cys)(Williams and Singh, 1988). In children, consumption of pulses should be encouraged, particularly in places where animal protein is scarce and expensive, as this would help to supplement the necessary amino acids required for their growth and development (Mukharjee *et al.*, 2017).

**Fat :**

Pulses have a very low-fat content, which ranges from 1 % (Lentil) to 6 % (Chickpea)(FAO database). Most of the pulses contain nearly 1 % fat which is very low compared to soybean (30 %) and peanut (49 %). Fats mainly serve as an energy source. However, they also act as a source of mono- and polyunsaturated fatty acids and contain plant-based sterols (Lovejoy, 2010; Patterson *et al.*, 2009).

**Vitamins :**

Pulses also act as a significant source of vitamins for human nutrition. Vitamins such asvitamin A, thiamine, riboflavin, pyridoxine, folic acid, vitamin E, niacin and vitamin K arefound in pulses (Campos-Vega *et al.*, 2010). The B vitamins act as co-enzymes in biological processes (Laquale, 2006). Vitamin Eserves as an anti-oxidant inhibiting the oxidation of vitamin A in the gastrointestinal tract (Mukharjee *et al.*, 2017) and of polyunsaturated fatty acids in the tissues (Traber and Atkinson, 2007). Vitamin K is necessary for the formation of blood clottingfactors(Mukharjee *et al.*, 2017).

**Minerals :**

Pulses are an important source of minerals such as calcium, magnesium, zinc, iron, potassium and phosphorous. These minerals are essential for the proper utilization of vitamins and other nutrients in the human body. They are required for the proper formation of blood and bone, heartbeat regulation, maintenance of healthy nerve function, reproduction and foetal development. They are also essential for growth and development, healing and energy release (Campos-Vega *et al.*, 2010).

**Phenolic compounds :**

The phenolic compounds of pulses comprise mainly phenolic acids, tannins and flavonoids (Campos-Vega *et al.*, 2010). The dark and highly pigmented colour of the pulses ispositively correlated to their total phenolic content. High phenolic content results in high antioxidant activity. Antioxidant activity can be measured by either DPPH scavenging capacity (µmol Troloxequivalents $g^{-1}$), FRAP value (mmol Fe2+ equivalents $100^{-1}$ g), or ORAC value (µmol Trolox equivalents $g^{-1}$) (Xu & Chang, 2007).

**Dietary fibre :**

Dietary fibre is an important non-nutritive component of food, which is not digested and absorbed by our body and is known to have various health benefits (Lattimer and Haub, 2010). One cup of cooked pulses supplies more than half the amount of fibre needed per capita/per day (Mukharjee *et al.*, 2017). Pulses contain both soluble (which dissolves in water to form gel-like material) and insoluble (which doesn't dissolve in water) fibre. Soluble fibre can help to manage body weight, blood sugar levels and lower cholesterol levels. Insoluble fibre, on the other hand, promotes the movement of material through the digestive system, increases stool bulk, and benefits people struggling with constipation or irregular stools (Singh *et al.*, 2016).

**Enzyme inhibitors :**

This class of bioactive compounds bind with any specific enzyme, form san enzyme-inhibitor complex, alters the active site conformation of the enzyme and finally reduces its catalytic activity. Key enzyme inhibitors reported in pulses are protease inhibitors (Trypsin and chymotrypsin inhibitors), á-amylase and á-glucosidase inhibitors and cholinesterase inhibitors (Belitz and Weder, 1990; Campos-Vega *et al.*, 2010). There are two types of protease inhibitors : (a) Kunitz type: It is made up of single chain polypeptide having two disulphide bridges. Its molecular weight is approximately 20 kDa. It inhibits the enzyme activity of trypsin only. (b) Bowman-Birk type : It is also made up of single-chain polypeptides but has seven disulphide bridges and its molecular weight is approximately 8kDa. It inhibits the enzyme activity of both trypsin and chymotrypsin(Liener, 1994). Several studies have suggested that protease inhibitors have anti-carcinogenic and anti-inflammatory activity (Srikanth and Chen, 2016). Amylase inhibitors slow down the amylase activity which results in slow digestion of starch and slow liberation of glucose and thus can benefit diabetic patients (Tundis*et al.*, 2010).

**Lectins :**

Lectins or hemagglutinins are carbohydrate-binding proteins that agglutinate the erythrocytes of blood. They are found in most plant foods, and also in pulses (Lajolo and Genovese, 2002). Lectins have antioxidant properties, and thus protect the body from damage caused by free radicals. Various reports have suggested that lectins are used as therapeutic agents to treatHIV (Nabi Afjadi *et al.*, 2022) cancer (Remmelink *et al.*, (1999), obesity (Pusztai, 1998) and diabetes (Aune *et al.*, 2013; de Munter*et al.*, 2007).

**Phytic acid :**

Phytic acid or myo inositolhexakis phosphate or IP6 is a major phosphorous storage form in plants. Phytates are present in all pulses (Sandberg, 2002). Due to its strong binding affinity towards minerals (iron, zinc, magnesium and calcium), protein and starch it reduces their bioavailability and is therefore considered an anti-nutritional factor (Weaver, 2002). Phytates regulate various cellular functions in the body such as DNA repair, chromatin remodelling, endocytosis and nuclear messenger RNA export etc (Zhou *et al.*, 1995; Midorikawa, 2001). Phytatesare known to have beneficial effects on human

health such as their role as an anti-carcinogen (Kerem *et al.*, 2005) and in decreasing the risk of heart disease and diabetes (Shamsuddin, 2002; Campos-Vega *et al.*, 2010).

**Phytosterols :**

Phytosterols are structural components of plant membranes. They are similar to cholesterol present in animals and humans. The most common phytosterols are â-Sitosterol, campesterol and stigmasterol (Benveniste, 1986). The total phytosterol content of pulses ranges from 134 mg/100g (kidney beans) to 242 mg/100g (peas) (Weihrauch and Gardener, 1978). Phytosterols are reported to have a role in lowering the blood cholesterol level (Duane, 1997).

**Saponins :**

Saponins are plant secondary metabolites which consist of carbohydrate moiety (mono - or oligosaccharides) attached to the steroid nucleus (aglycone) core. There is much structural diversity within this class of phytochemicals and only a few are toxic in nature whereas others have health-beneficial effects on the human body. Saponins from the pulses are used to treat, cardiovascular, neurological, respiratory, urological and other disorders. There are also many reports onthe anti-cancerous activity of saponins (Campos-Vega *et al.*, 2010).

**Conclusions :**

Pulses are a good source of bioactive components which have several health-promoting effects on the human body. Although there are several reports stating the use of pulses inthe prevention of chronic diseases such as cancer,diabetes and cardiovascular diseases still there are many research gaps that need to be addressed in this area. More epidemiological and clinical studies on the health effects of pulse bioactive components will further explore the health-promoting potential of pulses.

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